PATENT COOPERATION TREATY
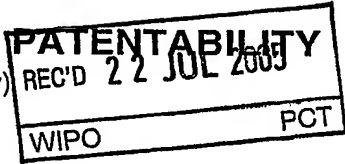
PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

REC'D 2 2 JUL 2005

WIPO   PCT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PU030197	FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/US2004/017176	International filing date *(day/month/year)* 28.05.2004		Priority date *(day/month/year)* 09.07.2003

International Patent Classification (IPC) or national classification and IPC
H04N7/26, H04N7/36

Applicant
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1. This report Is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, Including this cover sheet.

3. This report is also accompanied by ANNEXES, comprising:

   a. ☒ *sent to the applicant and to the International Bureau)* a total of 3 sheets, as follows:

      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).

      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

   ☒ Box No. I   Basis of the opinion

   ☐ Box No. II   Priority

   ☐ Box No. III   Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

   ☐ Box No. IV   Lack of unity of invention

   ☒ Box No. V   Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

   ☐ Box No. VI   Certain documents cited

   ☐ Box No. VII   Certain defects In the international application

   ☐ Box No. VIII   Certain observations on the international application

Date of submission of the demand 07.10.2004	Date of completion of this report 22.07.2005
Name and mailing address of the international preliminary examining authority: European Patent Office - Gitschiner Str. 103 D-10958 Berlin Tel. +49 30 25901 - 0 Fax: +49 30 25901 - 840	Authorized Officer Heising, G Telephone No. +49 30 25901-407

Box No. I   Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   ☐ international search (under Rules 12.3 and 23.1(b))
   ☐ publication of the international application (under Rule 12.4)
   ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-7   as originally filed

Claims, Numbers

1-10   received on 07.10.2004 with letter of 07.10.2004

Drawings, Sheets

1/4-4/4   as originally filed

   ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets/figs
   ☐ the sequence listing *(specify)*:
   ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets/figs
   ☐ the sequence listing *(specify)*:
   ☐ any table(s) related to sequence listing *(specify)*:

   *   *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	5,8-10
	No:	Claims	1-4,6,7
Inventive step (IS)	Yes:	Claims	8,9
	No:	Claims	1-7,10
Industrial applicability (IA)	Yes:	Claims	1-10
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1   The following documents are referred to in this communication:

D1 : EP 0 614 312 A (MATSUSHITA ELECTRIC IND CO LTD) 7 September 1994 (1994-09-07)

D2 : HAAN DE G ET AL: "MEMORY INTEGRATED NOISE REDUCTION IC FOR TELEVISION" IEEE TRANSACTIONS ON CONSUMER ELECTRONICS, IEEE INC. NEW YORK, US, vol. 42, no. 2, 1 May 1996 (1996-05-01), pages 175-181, XP000596763 ISSN: 0098-3063

2   NOVELTY

2.1   The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of **claim 1** is not new in the sense of Article 33(2) PCT.
Document D1 discloses all features of this claim (the references in parenthesis applying to this document):

A method for encoding a video signal with reduced noise, comprising the steps of: estimating motion for each macroblock in an input video signal N times where N is an integer greater than 1 to yield N sets of motion estimation decision sets (*page 2, lines 55-57 and page 5, lines 13-44 with figures 4 and 5, wherein according to figure 4 for a "current motion block" "m" different motion velocities "vm" are tested, according to figure 5 N=2L motion estimates between the block of the current frame and the blocks of N=2L neighboring frames are calculated and optimised jointly, wherein according to page 5, lines 43-44 the motion vectors are obtained by scaling the velocity "vm" according to the temporal distance of the respective neighboring frame*), each set including a reference picture index and motion vector (*page 5, lines 45-54 and equation 2, where l equals the reference picture index and v(l-k) the motion vector; see also: page 6, lines 6-8 and page 7, lines 41-44 for a correction vector relative to v(l-k) estimated for every block and frame*);

creating, for each macroblock, a noise reduced macroblock using the N sets of motion estimation data (*page 3, lines 2-6*); and
encoding each noise reduced macroblock using a best one of the motion estimation data sets (*page 4, lines 7-9 and lines 38-40 and page 7, lines 45-47*).

2.2 Furthermore, the present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of dependent **claims 2, 3 , 4 and 6** depending on claim 1 is not new in the sense of Article 33(2) PCT.
Document D1 discloses all features of these claims (the references in parenthesis applying to this document):

Claim 2:
The method according to claim 1 wherein the step of estimating motion further includes the step estimating the motion N times using each of N different reference pictures. (figure 5 and page 2, line 57 "matching the block in *each* of a plurality of ...frames")

Claim 3:
The method according to claim 1 wherein the step of creating the noise reduced macroblock further comprises the steps of:
selecting at least a plurality of the N sets of motion estimation decision sets; and
temporally filtering each pixel in the macroblock to using the selected motion estimation decision sets. (page 4, line 41 - page 5 line 5).

Claim 4:
The method according to claim 3 wherein the selecting step further comprises the steps of:
generating a predictor for each motion estimation decision set; (page 7, lines 6-20 with equation 3)
calculating a difference between the predictor and the current pixel; (page 7, equation 3)
determining whether the difference is less than a threshold; (page 8, lines 12-30 with equation 5, wherein the threshold equals $Tc * WTS/L$) and if so selecting the motion

estimation decision set whose difference is less than the threshold. (page 8, lines 29-30)

Claim 6:
Since claims 1 and 2 contain all the features of dependent claim 6 and since claims 1 and 2 are not new, the subject-matter of **claim 6** is also not new in the sense of Article 33(2) PCT.

2.3 Claim 7 is the corresponding apparatus claim to the above method claim 1. It is to be observed that each means of the apparatus is perfectly matching to one corresponding technical feature of the method claim.
Therefore, the subject-matter of **claim 7** does not meet the requirements of Article 33(1) PCT, because its subject-matter is not new in the sense of Article 33(2) PCT.

2.4 The subject-matter of claims 5 and 8-10 is novel (Article 33(2) PCT) since no single prior art was found which discloses all the features of any of these claims.

3   INVENTIVE STEP

3.1 The additional feature of dependent claim 5 over claim 1 is:

The method according to claim 1 further comprising the step of spatially filtering the input video prior to estimating motion.

This feature is a well known design option to improve a noise reduction system. This is shown for example in D2, where spatial filtering is presented as a well known means for noise reduction (page 175, left column, abstract and last paragraph). Furthermore, a cascade of spatial and temporal noise filtering is given in figure 7, where spatial filtering is performed before motion estimation. A skilled person would therefore use the feature of claim 5 in order to improve the noise reduction method of D1.
Thus, **claim 5** does not meet the requirements of Article 33(1) PCT, because its

subject-matter does not involve an inventive step in the sense of Article 33(3) PCT.

3.2 Claim 10 is the corresponding apparatus claim to the above method claim 5.
It is to be observed that each means of the apparatus is perfectly matching to one corresponding technical feature of the method claim.
Therefore, the subject-matter of **claim 10** does not meet the requirements of Article 33(1) PCT, because its subject-matter does not involve an inventive step in the sense of Article 33(3) PCT.

3.3 The subject-matter of **claims 8 and 9** does involve an inventive step (Article 33(3) PCT) since no prior art was found which discloses or gives a hint to the features of using coded pictures as references for motion estimation where the estimated multiframe motion information is used for temporal denoising the input images, which are to be coded.
The problem to be solved by these features is to decrease the computational load by using motion vectors, which are optimized for coding, for both denoising and coding.

4   INDUSTRIAL APPLICABILITY

Claims 1-10 disclose methods and apparatus for denoising for video coding applications. Therefore, the subject-matter of these claims is considered to be industrially applicable according to Article 33 (4) PCT.

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PCT/US2004/017176

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SUBSTITUTE SHEET
8

CLAIMS

1   1.   A method for encoding a video signal with reduced noise, comprising the steps of:

2   estimating motion for each macroblock in an input video signal N times (where N is an

3   integer greater than 1) to yield N sets of motion estimation decision sets, each set including a

4   reference picture index and motion vector;

5   creating, for each macroblock, a noise reduced macroblock using the N sets of motion

6   estimation data; and

7   encoding each noise reduced macroblock using a best one of the motion estimation data

8   sets.

1   2.   The method according to claim 1 wherein the step of estimating motion further

2   includes the step estimating the motion N times using each of N different reference pictures.

1   3.   The method according to claim 1 wherein the step of creating the noise reduced

2   macroblock further comprises the steps of:

3   selecting at least a plurality of the N sets of motion estimation decision sets; and

4   temporally filtering each pixel in the macroblock to using the selected motion estimation

5   decision sets.

1   4.   The method according to claim 3 wherein the selecting step further comprises the

2   steps of:

3   generating a predictor for each motion estimation decision set;

4   calculating a difference between the predictor and the current pixel;

5   determining whether the difference is less than a threshold; and if so

6   selecting the motion estimation decision set whose difference is less than the threshold.

1   5.   The method according to claim 1 further comprising the step of spatially filtering

2   the input video prior to estimating motion.

1

AMENDED SHEET

SUBSTITUTE SHEET

9

1   6.   A method for encoding a video signal with reduced noise, comprising the steps of:

2   estimating motion for each macroblock in an input video signal N times (where N is an

3   integer greater than 1) using each of N separate reference pictures to yield N sets of motion

4   estimation decision sets, each set including a reference picture index and motion vector;

5   creating, for each macroblock, a noise reduced macroblock using the N sets of motion

6   estimation data; and

7   encoding each noise reduced macroblock using the best one of the motion estimation data.

1   7.   A video encoder, comprising:

2   a motion estimation stage for estimating the motion in each macroblock of an input video

3   signal N times (where N is an integer greater than 1) to yield N sets of motion estimation decision

4   sets, each set including a reference picture index and motion vector,

5   a noise reducer for creating a noise reduced macroblock using the N sets of motion

6   estimation data;

7   encoding means for encoding the noise reduced macroblock.

1   8.   The encoder according to claim 7 further including a reference picture store for

2   storing coded pictures and where the motion estimation stage estimates the motion N times using

3   each of N different stored reference pictures.

1   9.   The encoder according to claim 7 further comprising:

2   a reference picture store for storing the coded pictures;

3   means for applying the stored previously coded pictures as input video stream to for

4   estimating the motion for each macroblock to yield the N sets of motion estimation decision sets;

5   while

6   means for applying the motion estimation decision sets to filter pictures for noise

7   reduction.

07. 10. 2004

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PCT/US2004/017176

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10

1   10.   The encoder according to claim 7 further comprising a spatial filter for

2   spatially filtering the input video prior to performing motion estimation.